TECHNICAL SPECIFICATION

ISO/TS 4869-5

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Acoustics — Hearing protectors —

Part 5: Method for estimation of noise reduction using fitting by inexperienced test subjects

Acoustique — Protecteurs individuels contre le bruit —
Partie 5: Méthode d'estimation de la réduction du bruit au moyen de réglages par des sujets d'essai non expérimentés

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 4869-5 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

ISO/TS 4869 consists of the following parts, under the general title *Acoustics — Hearing protectors*:

— *Part 1: Subjective method for the measurement of sound attenuation*

— *Part 2: Estimation of effective A-weighted sound pressure levels when hearing protectors are worn*

— *Part 3* [1]*: Measurement of insertion loss of ear-muff type protectors using an acoustic test fixture*

— *Part 4: Measurement of effective sound pressure levels for level-dependent sound-restoration ear-muffs (ISO/TR)*

— *Part 5: Method for estimation of noise reduction using fitting by inexperienced test subjects (ISO/TS)*

1) To be published.

The following part is under development:

— *Part 6: Active noise reduction of hearing protectors* [2)]

Annex A of this part of ISO 4869 is for information only.

2) Presently a preliminary work item.

Introduction

Hearing protectors are used to reduce the noise to which the ear is exposed. Hearing protectors are generally divided into ear-muffs and ear-plugs with a great variety of products within both categories. The measurement conditions given in this Technical Specification – making use of inexperienced hearing protector users – is believed to provide results that are representative for the noise reduction obtained by groups of typical users in real-world occupational settings.

The method described in ISO 4869-1 yields the sound attenuation of the hearing protector under test. The result of the measurement is a pure physical characteristic of the hearing protector.

The method described in this Technical Specification yields the performance of the system as a whole, i.e. hearing protector, test subjects, fitting and instruction.

Acoustics — Hearing protectors —

Part 5: Method for estimation of noise reduction using fitting by inexperienced test subjects

1 Scope

This Technical Specification specifies a method for measuring noise reduction of passive hearing protectors at the threshold of hearing. The method is designed to provide estimates of the noise reduction obtained by typical groups of users in real-world occupational settings, who may lack the training and motivation to wear hearing protectors in an optimum manner.

The principle of the test method is to measure the difference in hearing threshold with and without wearing a hearing protector. This difference between the thresholds constitutes the noise reduction. The measurement is done twice on a given number of test subjects.

NOTE 1 The principle of measuring the influence of a hearing protector on the hearing threshold is used in ISO 4869-1 and in this Technical Specification. The method described in ISO 4869-1 yields the sound attenuation of the hearing protector under test. The result of the measurement is a pure physical characteristic of the hearing protector. The method described in this Technical Specification yields the performance of the system as a whole, i.e. the influence of hearing protector, test subjects, fitting and instruction.

This test method yields data that are collected at low sound pressure levels (close to the threshold of hearing), but which are also representative of the noise reduction values of hearing protectors at higher sound pressure levels. This Technical Specification is inapplicable for level-dependent hearing protectors for sound pressure levels above the point at which their level-dependent characteristics become effective.

NOTE 2 At frequencies below 500 Hz, real-ear noise reduction data measured according to this Technical Specification may be spuriously high by a few decibels, with the error increasing as the frequency decreases. The error results from masking of the occluded-ear threshold by physiological noise during testing.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60263, *Scales and sizes for plotting frequency characteristics and polar diagrams*

IEC 60645-1, *Electroacoustics — Audiological equipment — Part 1: Pure-tone audiometers*

IEC 61260:1995, *Electroacoustics — Octave-band and fractional-octave-band filters*

IEC 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications*

Guide to the expression of uncertainty in measurement (GUM), BIPM/IEC/IFCC/ISO/IUPAC/IUPAP/OIML, ISBN 92-67-10188-9, 1993 [3)]

3) Corrected and reprinted in 1995.

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1
hearing protector
device worn by a person to reduce unwanted effects of sound

NOTE Hearing protectors can include electronic devices for communication or devices designed to play an active role in the reduction of the noise level between the hearing protector and the eardrum.

3.2
ear-muff
hearing protector consisting of an ear-cup to be pressed against each pinna or of a circumaural ear-cup to be pressed against the head around the pinna

NOTE The ear-cups can be pressed against the head with a special headband or neck-band or by means of a device attached to a safety helmet or other equipment.

3.3
ear-plug
hearing protector that either is inserted into the external ear canal or covers the ear canal entrance

NOTE Some ear-plugs are held in place by a lightweight band. They are sometimes called canal caps, semi-aural inserts, or banded ear-plugs.

3.4
helmet
device which covers a substantial part of the head

3.5
hearing level
⟨of a pure tone⟩ at a specified frequency, for a specified type of earphone and for a specified manner of application, the sound pressure level of this pure tone produced by the earphone in a specified acoustic coupler or artificial ear minus the appropriate reference equivalent threshold sound pressure level

NOTE Values of reference equivalent threshold sound pressure levels are specified in ISO 389-1.

3.6
hearing threshold level
⟨of a given ear⟩ at a specified frequency and for a specified type of earphone, the threshold of hearing expressed as hearing level

NOTE For appropriate measurement procedures see, for example, ISO 6189 and ISO 8253-1.

3.7
threshold of hearing
lowest sound pressure level at which, under specified conditions, a person gives a predetermined percentage of correct detection responses on repeated trials

NOTE For the purpose of this Technical Specification, the threshold of hearing is measured with and without the hearing protector. For appropriate test conditions, see ISO 8253-2.

3.8
occluded-ear threshold of hearing
threshold of hearing when a hearing protector is worn

3.9
open-ear threshold of hearing
threshold of hearing when no hearing protector is worn

3.10
individual noise reduction
for a given test signal and a selected test subject, the difference between the occluded-ear threshold of hearing and the open-ear threshold of hearing, i.e. the threshold with and without the hearing protector

NOTE The individual noise reduction is expressed in decibels.

3.11
group noise reduction
for a given test signal, the mean of the individual noise reductions for a group of test subjects

3.12
pink noise
noise in which sound power spectral density is inversely proportional to frequency

3.13
reference point
fixed point within the test chamber; the test subject is positioned so that the mid-point of a line connecting the subjects' ear canal openings coincides with the reference point

NOTE All objective measurements of the sound field characteristics are referenced to the reference point.

3.14
reverberation time
time required for the sound pressure level to decrease by 60 dB after the sound source has stopped

NOTE See ISO 354.

4 Measurement of the noise reduction of hearing protectors

4.1 Test signals

The test signals shall consist of a signal from pink noise filtered through one-third-octave bands with centre frequencies in accordance with IEC 61260. At a minimum, the following centre frequencies shall be tested:

125 Hz, 250 Hz, 500 Hz, 1 000 Hz, 2 000 Hz, 4 000 Hz and 8 000 Hz

4.2 Test site

4.2.1 Conditions to be met for the test to be valid

a) With the test subject and the subject's chair absent, the sound pressure level measured with an omnidirectional microphone at positions 15 cm from the reference point on the front back, right-left and up-down axes shall deviate by no more than ± 2,5 dB from the sound pressure level at the reference point for any of the test signals. Further, the difference between the extreme right-left positions shall not exceed 3 dB. The orientation of the microphone shall be kept the same at each position.

b) At frequencies of 500 Hz and above, the sound pressure level at the reference point shall be within 5 dB for the two directions of measurement that give maximum and minimum readings of the incident sound energy when measured with a directional microphone with a front-to-random sensitivity index of 5 dB. For other directional microphones, the relationship between the front-to-random sensitivity index and the allowable field variation is given in Table 1.